

HOUSING ASSEMBLY FOR AN AIR BAG AND VEHICLE HORN SWITCH

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus for enclosing an air bag on a steering wheel of a vehicle having a horn.

A known apparatus for enclosing an air bag on a steering wheel of a vehicle having a horn is disclosed in U.S. Pat. No. 5,002,306. U.S. Pat. No. 5,002,306 also discloses two horn switches enclosed by the apparatus. The horn switches are located on opposite sides of a tear seam in an air bag cover. Each horn switch has connectors for connecting the horn switch to a source of electrical energy in the vehicle.

SUMMARY OF THE INVENTION

The present invention provides a new and improved apparatus for enclosing an air bag on a steering wheel of a vehicle having a horn. The apparatus of the present invention includes an inner cover which at least partially encloses the air bag. The inner cover has a tear seam. An outer cover at least partially encloses the inner cover and the air bag. The outer cover also has a tear seam which overlies the tear seam on the inner cover. A vehicle horn switch is disposed between the inner and outer covers.

The horn switch includes first and second spaced apart tear seams. The first and second tear seams in the horn switch are aligned with the tear seams in the inner and outer covers and have a combined length substantially less than the length of each of the tear seams in the inner and outer covers. When the air bag inflates, the tear seams in the inner cover, in the outer cover and in the horn switch are ruptured by the inflating air bag.

The horn switch includes first and second layers of electrically conductive material. Each layer of electrically conductive material includes two layer portions located on opposite sides of the tear seams in the inner and outer covers. The two layer portions are interconnected by an interconnecting portion which extends across the tear seams in the inner and outer covers. An envelope of electrically insulating material extends around the first and second electrically conductive layers of the horn switch. The envelope also has portions extending around the interconnecting portions. The envelope and interconnecting portions comprise spaced portions of the horn switch and have tear lines along which the envelope and interconnecting portions rupture which define the first and second tear seams in the horn switch.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other features of the present invention will become apparent to one skilled in the art to which the present invention relates upon consideration of the following description of the invention with reference to the accompanying drawings, wherein:

FIG. 1 is a schematic plan view illustrating an apparatus for enclosing an air bag on a vehicle steering wheel;

FIG. 2 is an enlarged, schematic, sectional view, taken generally along the line 2—2 of FIG. 1;

FIG. 3 is a schematic plan view illustrating a first embodiment of a horn switch of the present invention;

FIG. 4 is an enlarged sectional view, taken generally along the line 4—4 of FIG. 3;

FIG. 5 is an enlarged sectional view, taken generally along the line 5—5 of FIG. 3;

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FIG. 6 is a schematic plan view of a layer of electrically conductive material of the horn switch of FIG. 3;

FIG. 7 is a schematic plan view of another layer of electrically conductive material of the horn switch of FIG. 3; and

FIG. 8 is a schematic plan view illustrating a second embodiment of a horn switch of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS EMBODIMENTS OF THE PRESENT INVENTION

In accordance with the present invention, an air bag module 20 (FIGS. 1 and 2) is mounted on a steering wheel 22 of a vehicle. The air bag module 20 includes a housing assembly 24. The housing assembly 24 includes a generally rectangular metal base 28 (FIG. 2) which is connected with the steering wheel by suitable connectors (not shown).

The housing assembly 24 also includes a relatively stiff inner cover 34 connected to the base 28. The inner cover 34 encloses an air bag 38, partially shown in FIG. 2. A resiliently deflectable outer cover 36 encloses the inner cover 34 and the air bag 38. The inner cover 34 has an outer wall 40 and side walls 42 extending from the outer wall 40. The side walls 42 are connected to the base 28. The outer cover 36 has an outer wall 44 covering the outer wall 40 of the inner cover 34 and side walls 46 extending from the outer wall 44. The side walls 46 are connected to the base 28.

The outer cover 36 has weakened areas providing a tear seam 48 preferably having an H-shape (FIG. 1). A central portion 49 of the tear seam 48 extends across the outer wall 44 of the outer cover 36 between legs 51 of the H-shaped tear seam 48. The inner cover 34 also has weakened areas providing a tear seam which is also H-shaped. The tear seam in the inner cover 34 (FIG. 2) lies directly under the tear seam 48 and has a central portion 50 that lies directly under the portion 49 of the tear seam 48. The tear seam central portion 50 has substantially the same length as the tear seam central portion 49.

The air bag 38 (FIG. 2) is connected with the base 28 in any suitable manner. As illustrated, the air bag 38 is connected with base 28 by an annular metal clamp ring 52 and suitable fasteners (not shown). The clamp ring 52 clamps an open end or mouth of the air bag 38 to the base 28. The air bag 38 is clamped around a generally cylindrical air bag inflator 54. The inflator 54 is also secured to the base 28 in a suitable manner. The inflator 54 provides a source of fluid for inflating the air bag 38. The inflator may have many different constructions as is known.

Upon the occurrence of sudden vehicle deceleration requiring air bag inflation, a suitable control apparatus (not shown) activates the inflator 54. The inflator 54, when activated, emits a flow of fluid which inflates the air bag 38. As the air bag 38 inflates, the air bag applies pressure to the inside of the inner cover 34. In response to the pressure, the inner cover 34 ruptures along the tear seam 50, and the outer cover 36 ruptures along the tear seam 48. The pressure applied by the air bag 38 against the inside of the inner cover 34 pivots portions of the inner cover and the outer cover 36 out of the path of inflation of the air bag 38. The air bag 38, when inflated, restrains the vehicle driver from forcefully striking structural parts of the vehicle, such as the steering wheel 22.

A horn switch 58 (FIGS. 2 and 3) is disposed between the inner and outer covers 34 and 36. The horn switch 58 is connected to the inner cover by threaded fasteners 59 (FIG.

2). The horn switch 58 is connected with ground and a source of electrical energy, such as a vehicle battery, through conductors 60 and 62 and a connector 63 (FIG. 3).

The horn switch 58 has an area that is approximately the same as the area of the outer walls 40 and 44 of the inner and outer covers 34 and 36. When the vehicle horn is to be operated, pressure is manually applied against the outer cover 36 to actuate the horn switch 58 and effect operation of the vehicle horn.

The switch 58 has first and second spaced tear seams 64 and 65 (FIG. 3). The switch 58 ruptures along the tear seams 64, 65 upon inflation of the air bag 38. The tear seams 64, 65 may be defined by weakened or perforated areas. The tear seams 64, 65 overlie the central portion 50 of the tear seam in the inner cover 34. Because the central portion 50 is aligned with the central portion 49 of the tear seam 48 in the outer cover 36, the central portion 49 overlies the tear seams 64, 65.

The combined lengths of the first and second tear seams 64 and 65 is substantially less than the lengths of each of the tear seam central portions 49 and 50. The combined lengths of the first and second tear seams 64 and 65 is about one-sixth ($\frac{1}{6}$) the length of each of the tear seam central portions 49 and 50. Since only a small portion of the horn switch 58 ruptures as compared to the inner and outer covers 34 and 36, the horn switch has a minimum retarding effect on inflation of the air bag.

The switch 58 includes a pair of generally flat, flexible, overlying layers 70 and 72 (FIGS. 4-7) of electrically conductive material. Dots or bumps 76 (FIGS. 4 and 5) of polymeric material, which is electrically insulating, are disposed between the layers 70 and 72. The bumps 76 are secured to the layer 70 and engage the layer 72 to separate the two layers until pressure is applied to deflect the layers 70, 72 into engagement with one another. Engagement of the layers 70 and 72 completes an electrical connection to effect operation of the vehicle horn. The layers 70, 72 engage when sufficient pressure is manually applied against the outer cover 36.

The layer 70 (FIGS. 4 and 6) includes layer portions 80 and 82 spaced apart from each other on opposite sides of the tear seam 64 of the horn switch 58. An interconnecting portion 84 of the layer 70 interconnects the portions 80 and 82 and extends across the central portions 50 and 49 of the tear seams in the inner and outer covers 34 and 36. The interconnecting portion 84 includes a tear line 86 (FIG. 6) along which the interconnecting portion ruptures upon air bag inflation. The tear line 86 is aligned with the tear seam central portions 50 and 49 in the inner and outer covers 34 and 36. The tear line 86 of the interconnecting portion 84 may or may not be weakened or perforated since the thickness of the interconnecting portion is small enough that it will easily tear upon inflation of the air bag. The layer portion 82 includes an extension 88 which is connected to the conductor 60.

The portions 80 and 82 of the layer 70 include spaced apart, parallel edge portions 90 and 92, respectively (FIG. 6). Each of the edge portions 90 and 92 extends adjacent and parallel to the central portions 50 and 49 of the tear seams in the inner and outer covers 34 and 36. The interconnecting portion 84 has a dimension measured along the tear line 86 which is substantially less than the length of each of the tear seam portions 49 and 50 and also substantially less than the length of each of the edge portions 90 and 92, as can be clearly seen in FIG. 6. The length of the tear line 86 is less than about one-tenth ($\frac{1}{10}$) the length of each of the tear seam central portions 49 and 50.

The layer 72 (FIGS. 5 and 7) includes layer portions 96 and 98 spaced apart from each other on opposite sides of the tear seam 65 in the horn switch 58. An interconnecting portion 100 of the layer 72 interconnects the portions 96 and 98 and extends across the tear seam central portions 50 and 49 in the inner and outer covers 34 and 36. The interconnecting portion 100 includes a tear line 102 (FIG. 7) along which the interconnecting portion 100 ruptures upon air bag inflation. The tear line 102 is aligned with the tear seam central portions 49 and 50. The tear line 102 of the interconnecting portion 100 may or may not be weakened or perforated since the thickness of the interconnecting portion 100 is small enough that it will easily tear upon inflation of the air bag. The portion 98 includes an extension 104 which is connected to the conductor 62.

The portions 96 and 98 of the layer 72 have spaced apart, parallel edge portions 108 and 110, respectively, that extend adjacent and parallel to the tear seam central portions 50 and 49 in the inner and outer covers 34 and 36. The interconnecting portion 100 has a dimension measured along the tear line 102 which is substantially less than the length of each of the tear seam central portions 49 and 50 and substantially less than the length of each of the edge portions 108 and 110. The length of the tear line 102 is less than about one-tenth ($\frac{1}{10}$) of the length of each of the tear seam central portions 49 and 50. The interconnecting portion 100 (FIG. 3) is spaced apart from the interconnecting portion 84 of the layer 70 along a line 114 (FIG. 3) containing the tear lines 86 and 102.

The two layers 70 and 72 of electrically conductive material are enclosed by an envelope 120 (FIGS. 3-5) of electrically insulating material. The layers 70 and 72 and the envelope 120 are interconnected for installation in and removal from the housing assembly 24 as a unit. The envelope 120 includes a portion 122 enclosing the portions 80 and 96 of the layers 70 and 72. A portion 124 of the envelope 120 encloses portions 82 and 98 of the layers 70 and 72. The portions 122 and 124 are spaced apart from each other and located on opposite sides of the tear seams 64, 65 in the horn switch 58.

A portion 126 of the envelope 120 extends around the interconnecting portion 84 of the layer 70. A portion 128 of the envelope 120 extends around the interconnecting portion 100 of the layer 72 and is spaced apart from the portion 126. The portions 126 and 128 of the envelope 120 have tear lines along which the portions 126 and 128 rupture upon air bag inflation. The tear lines in the portions 126 and 128 are directly aligned with the tear lines 86 and 102 in the interconnecting portions 84 and 100 of the layers 70 and 72. The tear lines in the portions 126 and 128 may or may not be weakened or perforated since the thickness of the portions 126 and 128 is small enough that they will easily tear upon inflation of the air bag. The tear lines 86 and 102 in the interconnecting portions 84 and 100 and the tear lines in the portions 126 and 128 of the envelope 120 define the first and second tear seams 64 and 65 of the horn switch 58.

The envelope 120 is formed by a pair of generally flat layers 134 and 136 (FIGS. 4 and 5) of electrically insulating polymeric material. The layers 134 and 136 of electrically insulating material are disposed in a side-by-side relationship with the layers 70 and 72 of electrically conductive material. The layers 134 and 136 are bonded together along a flat rim portion 138 to form the envelope 120. The flat rim portion 138 extends around the periphery of the layers 70 and 72 of electrically conductive material. The flat rim portion 138 includes openings 140 for receiving the fasteners 59 to connect the horn switch 58 to the inner cover 34.